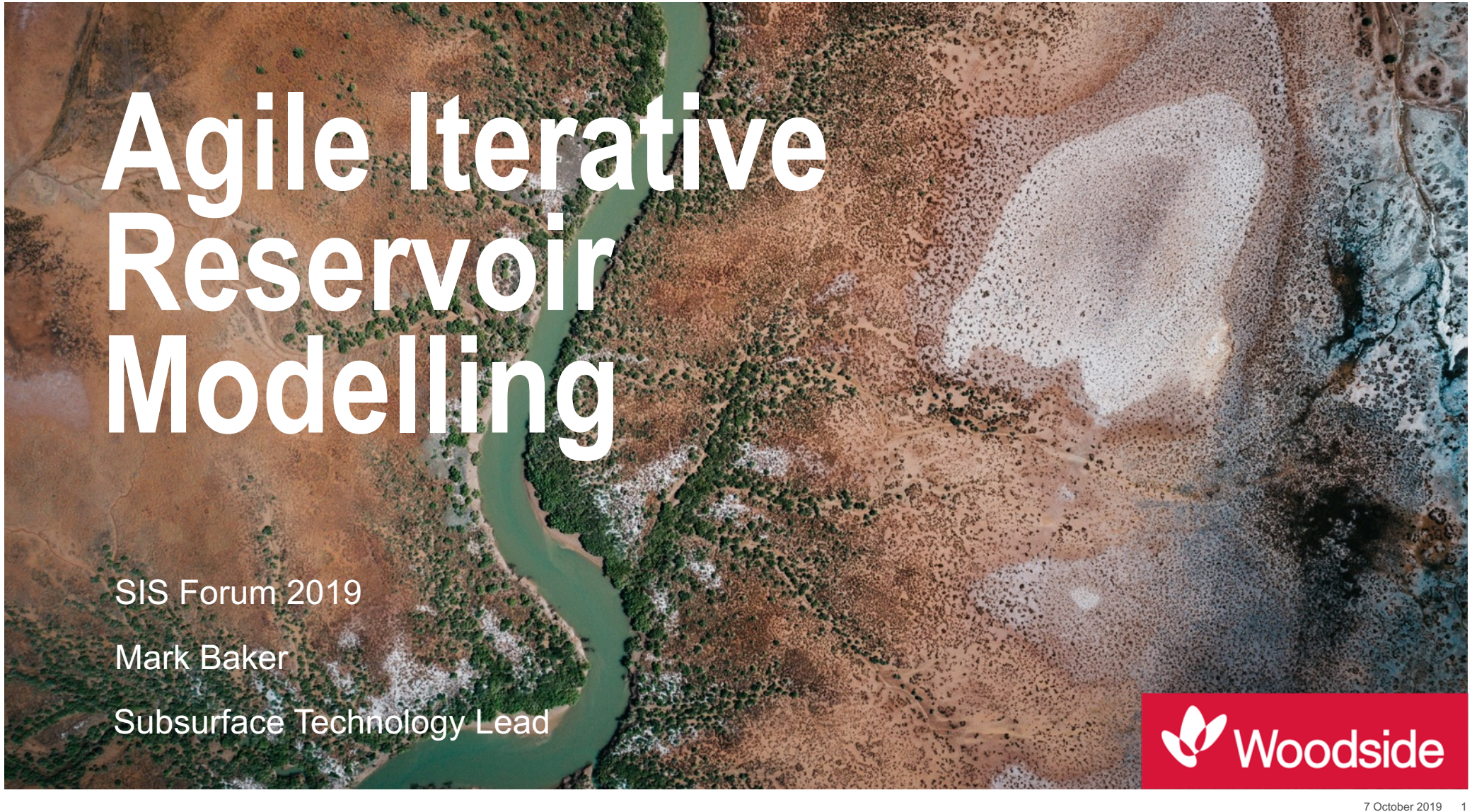

# Agile Iterative Reservoir Modelling

SIS Forum 2019

Mark Baker

Subsurface Technology Lead

Woodside

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All references to dollars, cents or $ in this presentation are to US currency, unless otherwise stated.

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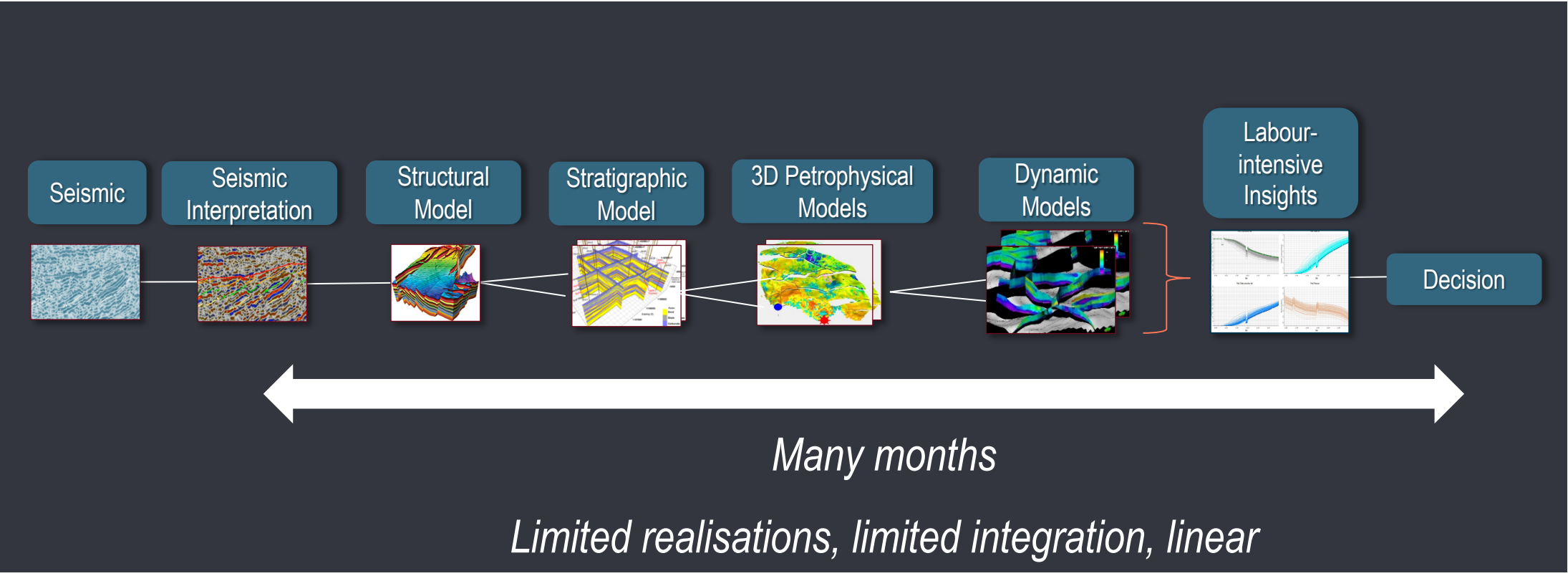
# The Subsurface Interpretation Challenge

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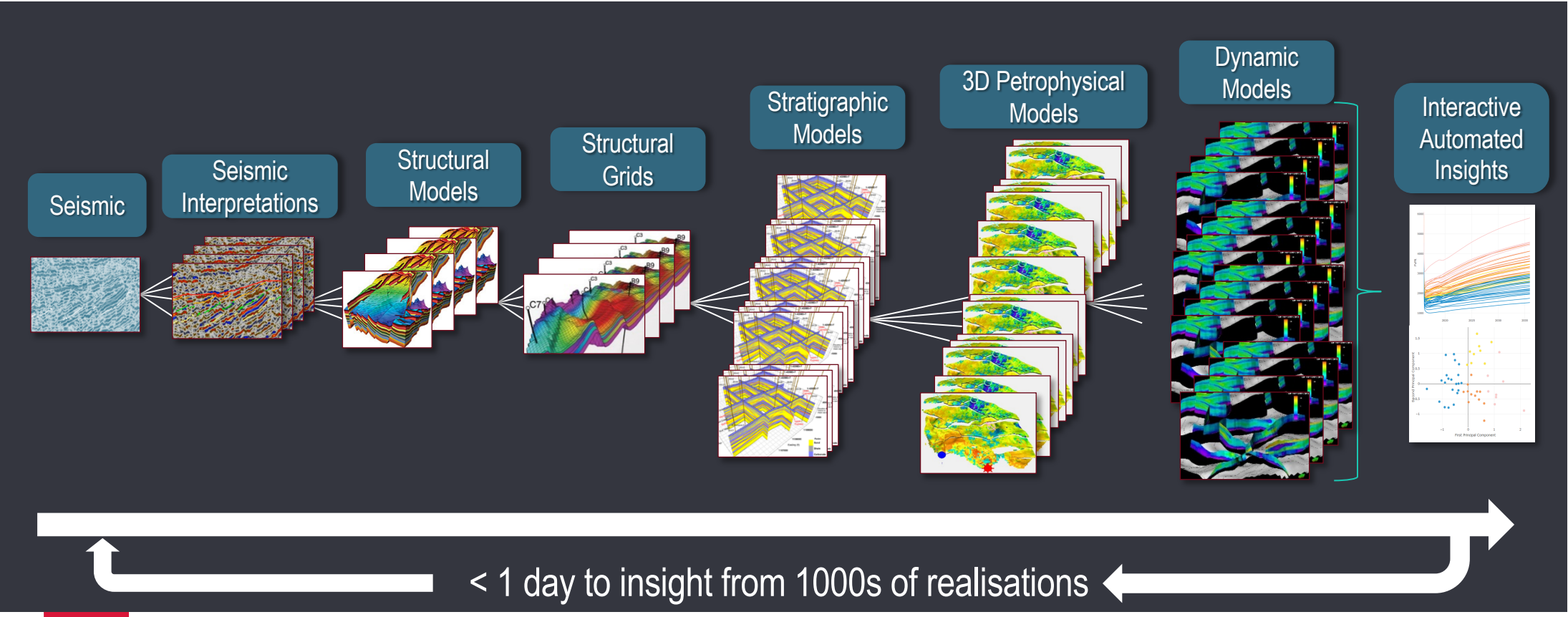
Schlumberger

# The Subsurface Interpretation Challenge

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Schlumberger

# Agile Iterative Reservoir Modelling

Woodside worked with Schlumberger to explore what is possible with the new technology behind DELFI and show the power of openness for reservoir modelling

**Objectives:**

- Build an assisted reservoir modelling application to:
    - Reduce reservoir modelling cycle time
    - Enable collaborative, iterative working styles for integrated teams
    - Improve information for decision-making
    - Unlock subsurface and production data for next-level analysis
- Explore the flexibility and openness of DELFI by developing a new tool inside the DELFI environment
- Enable assisted quality control at each step to build trust in the process

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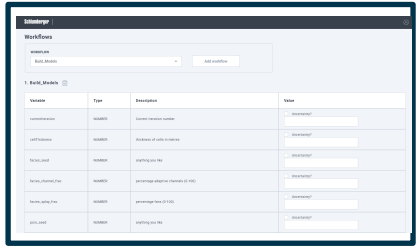
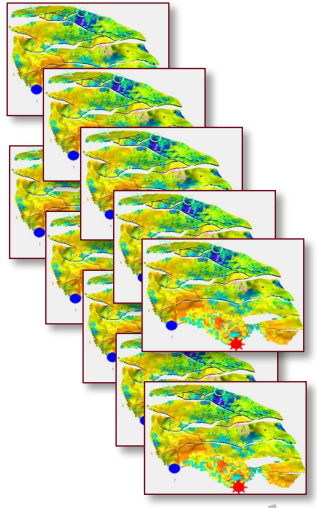
# Agile Iterative Reservoir Modelling

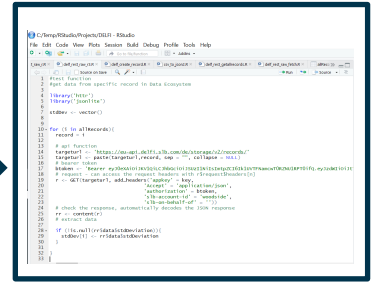
**Parallel Petrel and Intersect processes**

**DELFI web app**

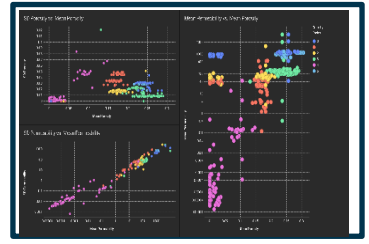





**Woodside Analytics Engine**



**Spotfire**



**Data Ecosystem**

Custom Databases

DELFI Stores

# Greenfield Development Application

**Objective: field development insights with focus on subsurface uncertainty**

- Full modelling workflow from seismic interpretation to simulation
- Incorporated Schlumberger's seismic interpretation and static model automation
- Quality control incorporated at all steps – tracked throughout process using Data Ecosystem and viewable on Spotfire
- Process is automated and highly parallelisable

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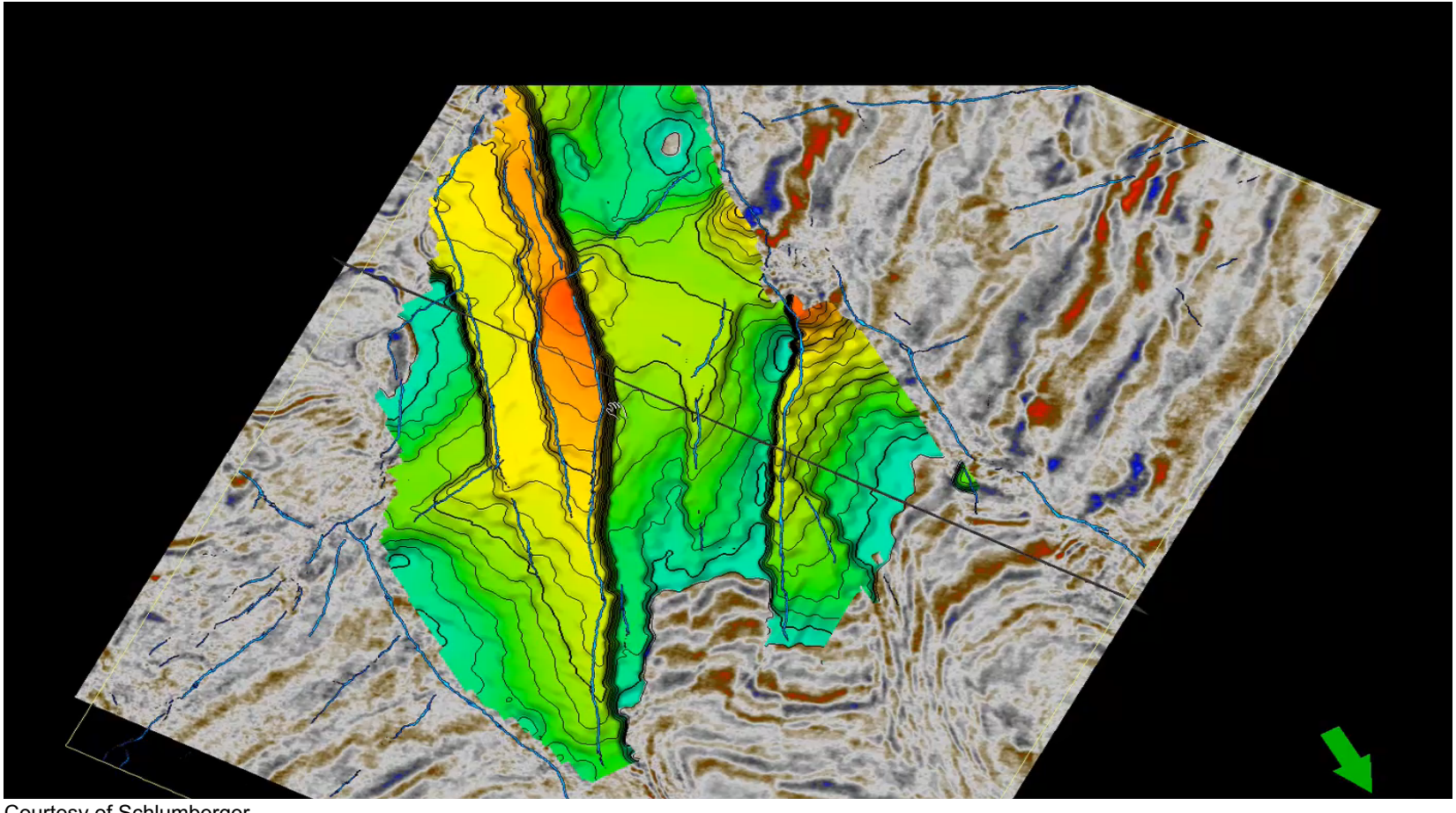
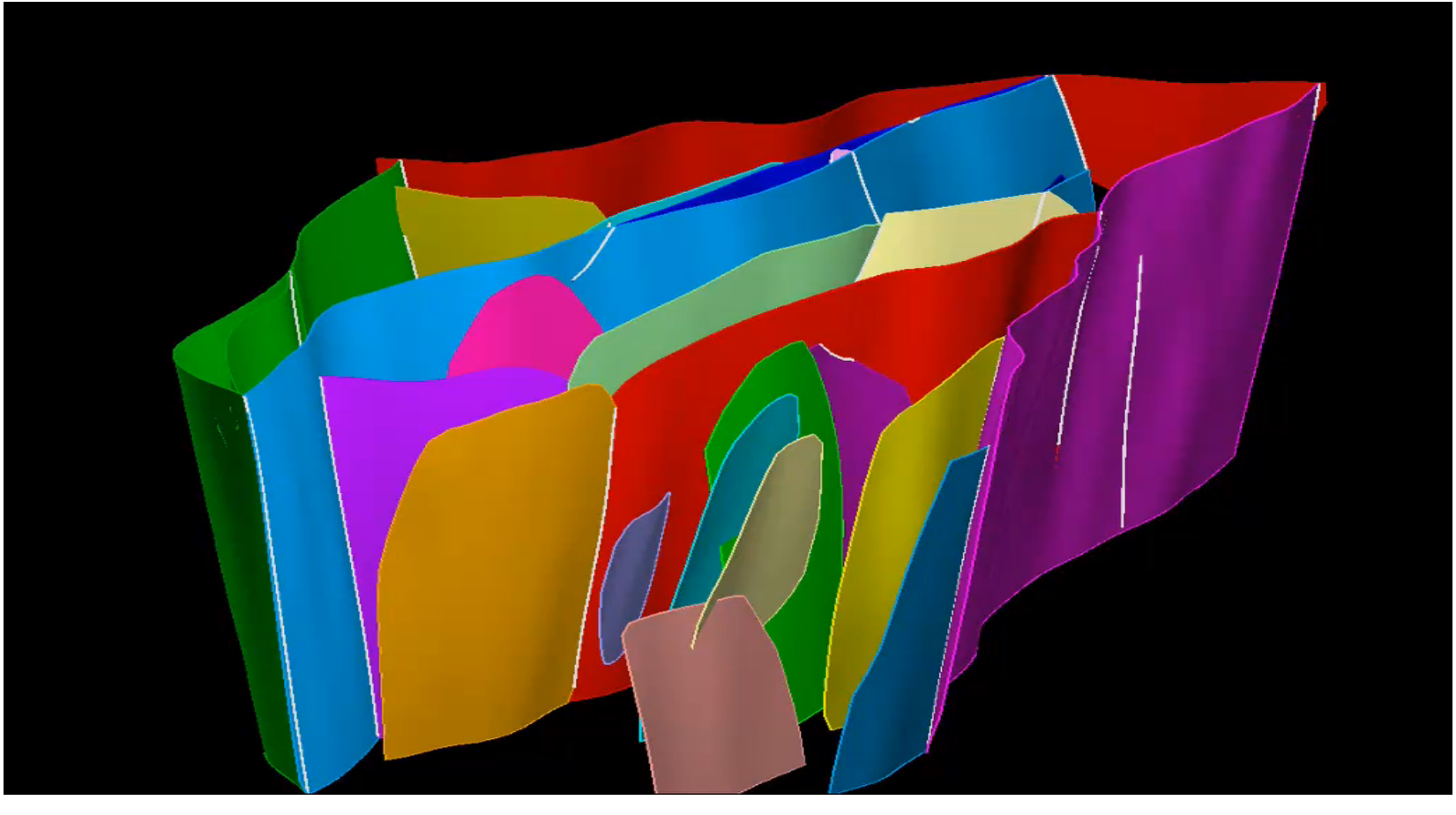
# Automated Structural Modelling



Courtesy of Schlumberger

# Automated Static Modelling



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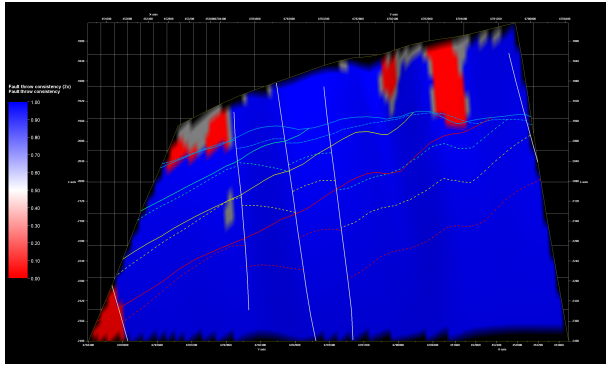
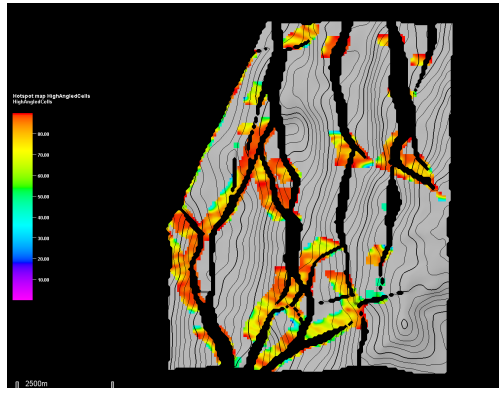
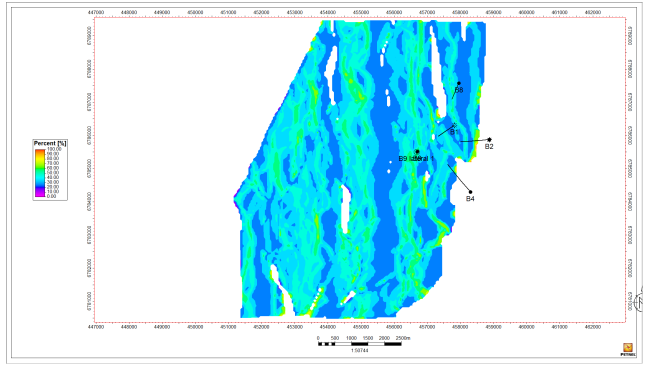
# Assisted QC



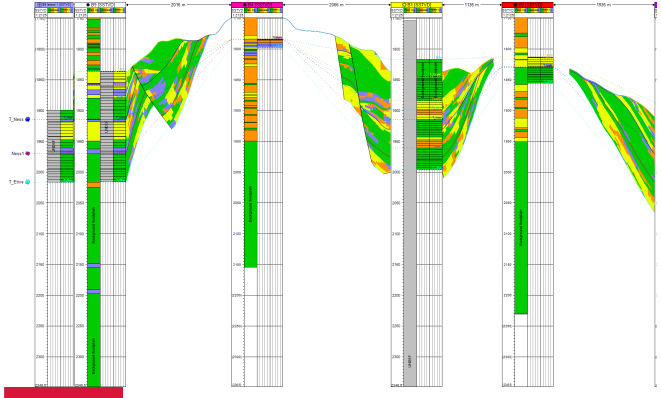
Fault throw consistency



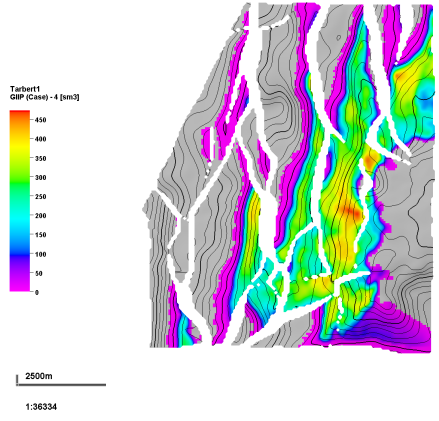
Problem cell hotspot map



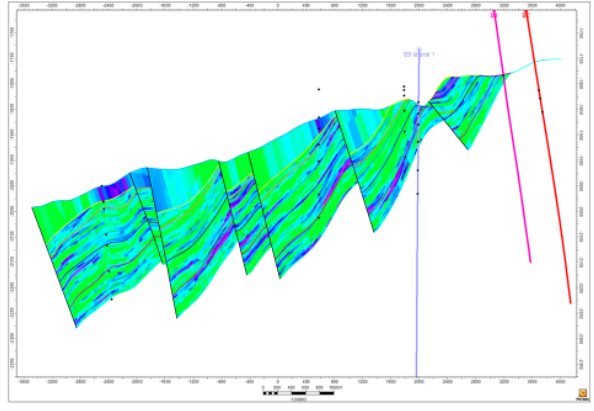
Facies proportion map



Well section

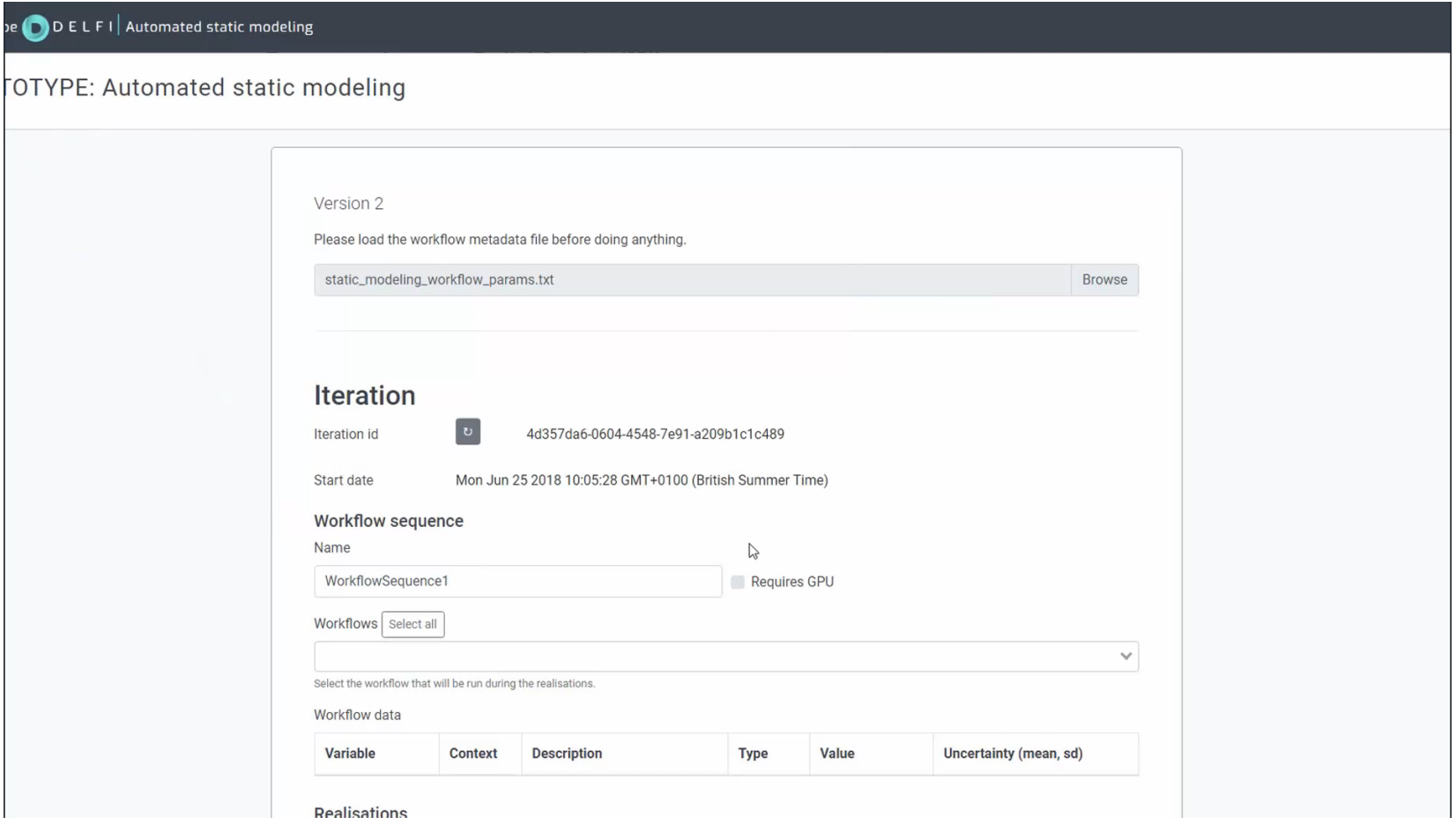


GIIP map

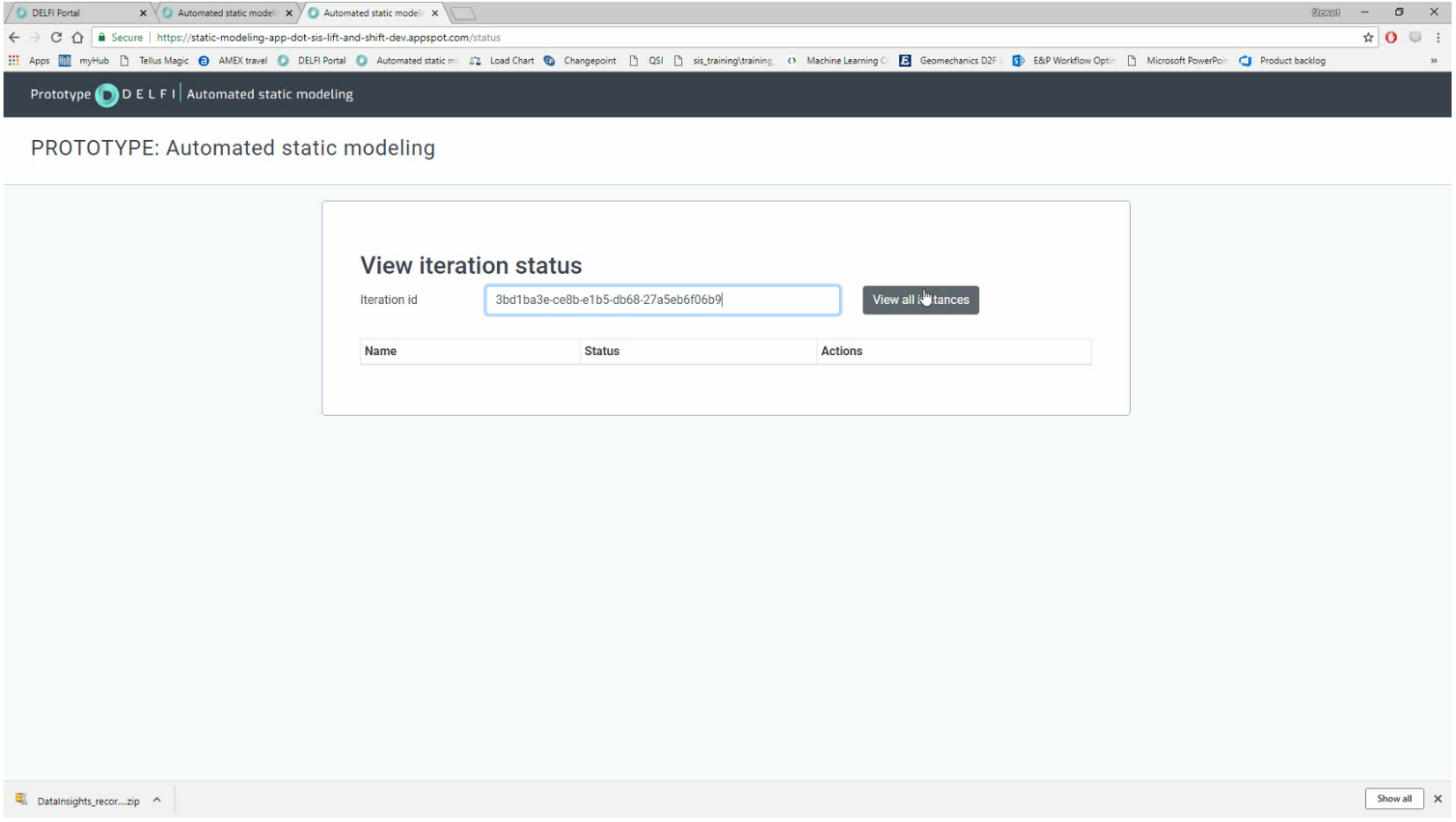


Model cross-section

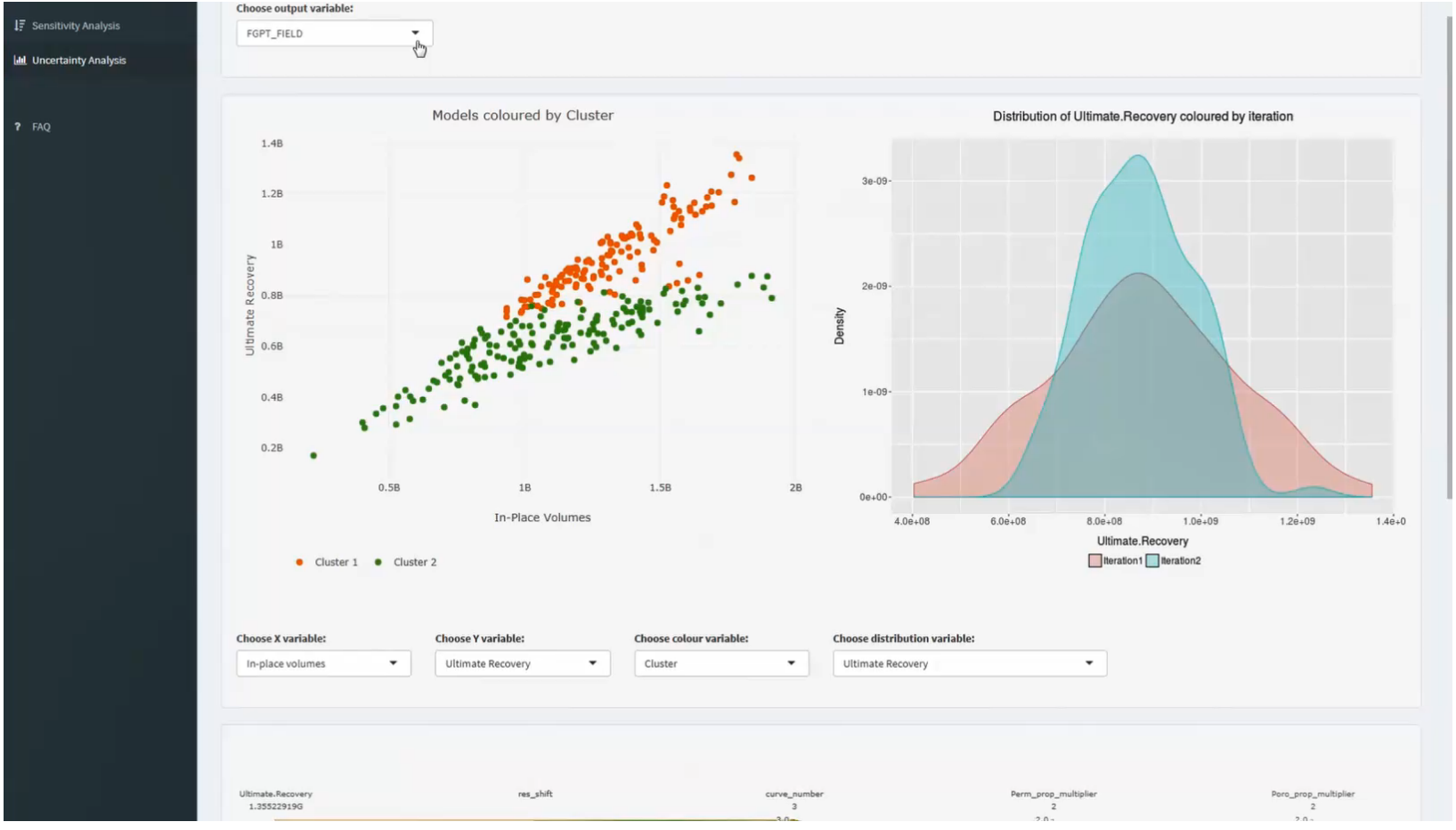
# Automated Static Modelling



# Automated Static Modelling



# Automated Insights



# Appraisal Insights Application

**Objective: field development insights from appraisal well test**

- Integrated subsurface team identified 36 uncertainties from seismic interpretation to spatial distribution of facies to aquifer strength
- 15 complete iterations in less than a week – each iteration 50 to 100 reservoir models from seismic to simulation
- Process allowed different hypotheses to be robustly tested within an hour
- Twice daily meetings with integrated subsurface team to examine results, discuss hypotheses and plan next iteration
- Prompted a fundamental rethink of net-to-gross and permeability log interpretations

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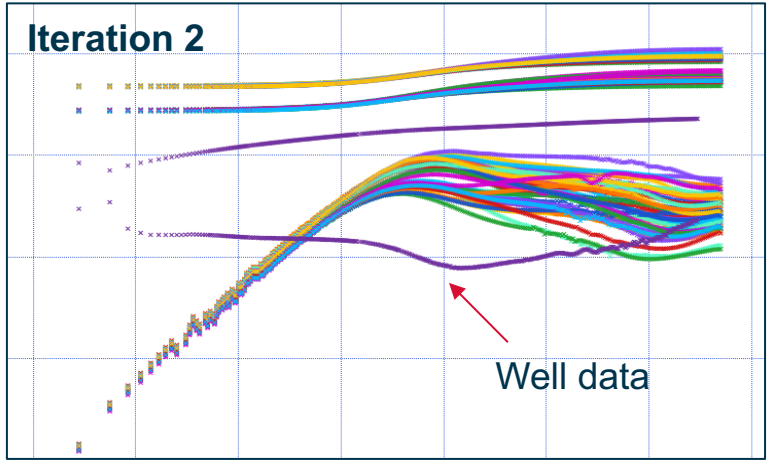
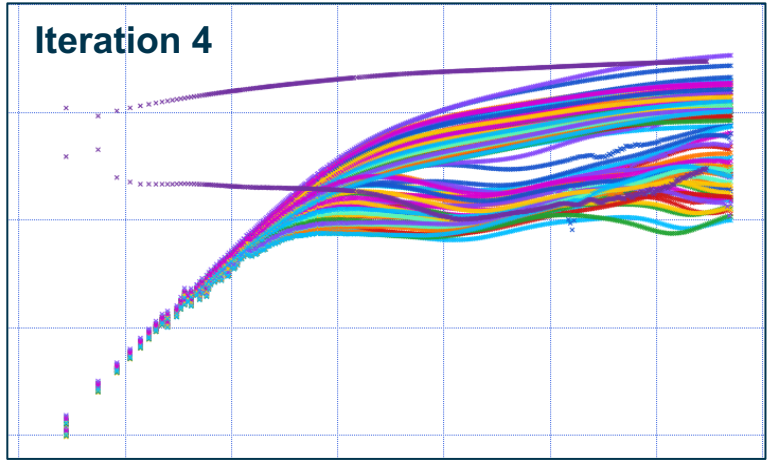
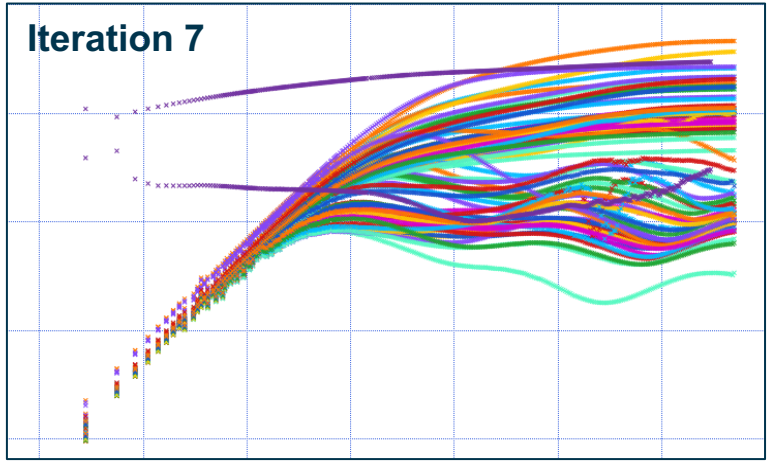
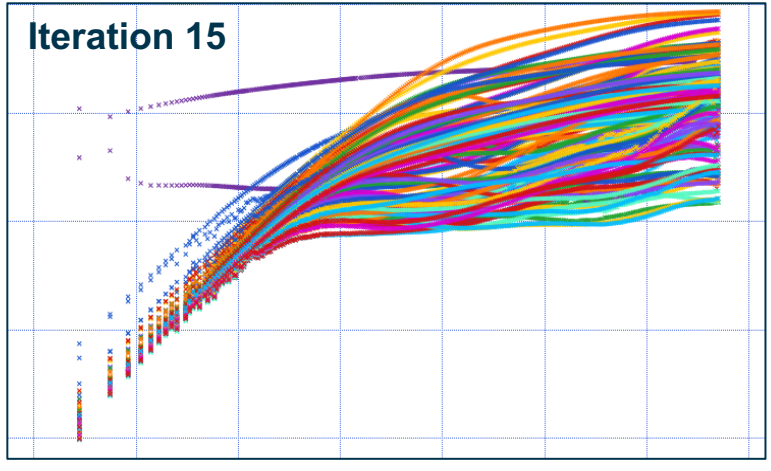
# Appraisal Insights Application

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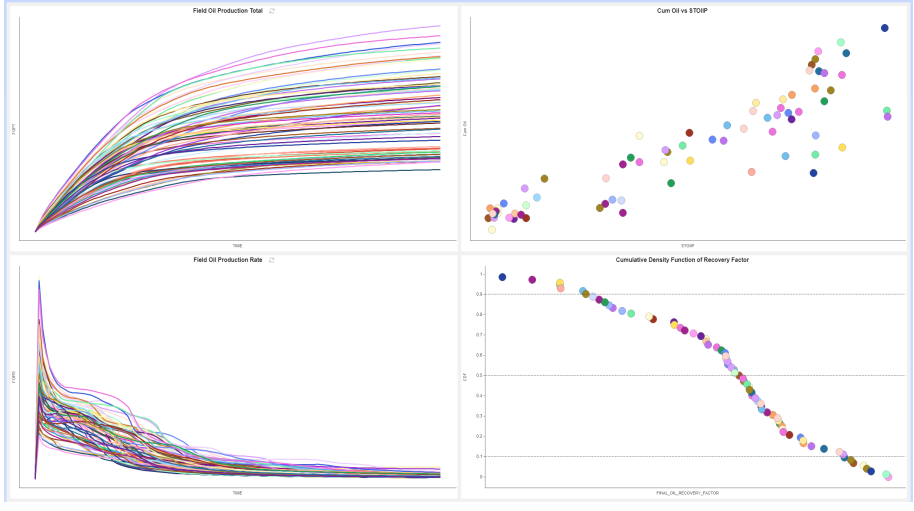
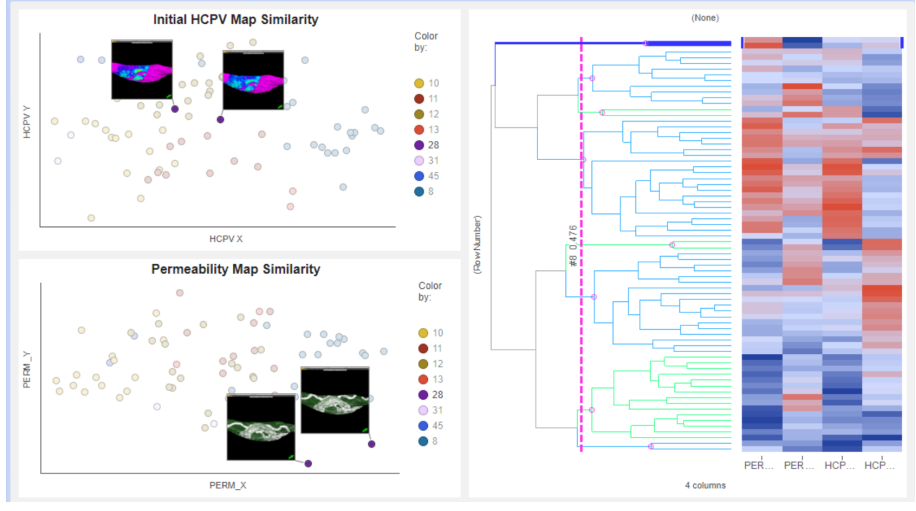
# Oil Field Development Application

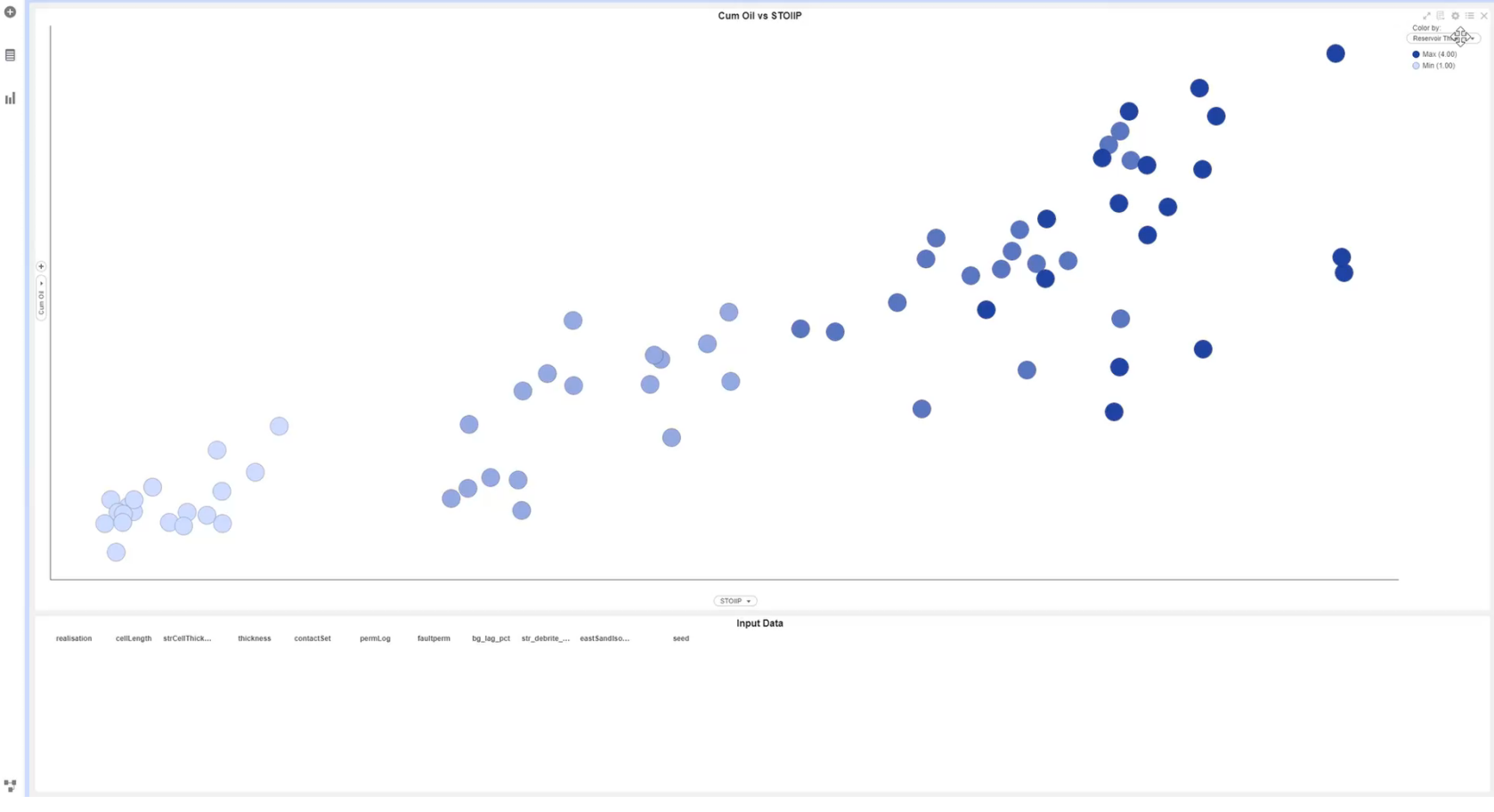
**Objective: reserves update for oil field development with production data**

- Two hours to complete full iteration of 300 unique reservoir models with forecasts
- Fully linked static and dynamic QC with production data calibration for model falsification
- 75% reduction in model cycle time



# Oil Field Development Application



# Conclusions

- DELFI's openness allowed for a fundamental reframe of the reservoir modelling process, with a strong focus on automation, speed and data management.
- Applied to greenfield, appraisal and brownfield applications with significant improvement in model cycle times, collaboration between disciplines and better uncertainty range quantification.
- Access to APIs and cloud compute can streamline workflows to get almost real-time results from modelling studies.
- Removing manual and siloed work allows subsurface professionals more time to collaborate, to explore, and to improve development outcomes.

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# Special Thanks

Thank you to Steve Freeman and everyone at SIS Perth, Leeds, Abingdon and Oslo.

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